HAED-Jo: postharvest systems Fact-finding mission

Four-day mission

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WAGENINGEN
UNIVERSITY & RESEARCH

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Abbreviations:

BP	Business plan light
CIS	Commonwealth of Independent States
EC_w	Electro Conductivity of the irrigation water (salinity)
F&V	Fruit and vegetables
IPM	Integrated Pest Management
JOD	Jordanian Dinar (1 JOD = € 1,20)
JV	Jordan Valley
KSA	Kingdom of Saudi Arabia
MoA	Ministry of Agriculture
MRLs	Maximum Residue Levels
PE	Polyethylene
RH	Relative Humidity
SOP	Standard Operating Procedure
UAE	United Arab Emirates
WFBR	Wageningen Food & Biobased Research
WSM	Wholesale market
WUR	Wageningen University & Research

1 Introduction

1.1 Background

The Jordan Hydroponics Agriculture and Employment Development Project (HAED-Jo) aims to advance efficient farming in Jordan and create employment opportunities for Jordanians and Syrian refugees in agricultural production and associated postharvest chains. The project, funded by the Ministry of Foreign Affairs of the Netherlands to be implemented from 2017-2019 focuses on increasing resilience of the hosting communities in Jordan. The project is implemented by a consortium led by ECO Consult. Wageningen University & Research (WUR) is part of the consortium.

One of the key areas is supporting communities to utilize postharvest systems in order to create jobs and increase the livelihoods of Jordanians and Syrian refugees within host communities. This report presents the results of the first fact-finding mission that was executed 03-03-2018 until 03-09-2018. The results intend to facilitate ECO Consult, Wageningen University & Research (WUR) and the private sector to scope the research and implementation activities of the HAED-Jo programme the upcoming 2 years.

1.2 Objectives

The objectives of this study are:

- to review existing postharvest systems and practices in Jordan including the Jordan valley and highlands and develop an assessment of these systems;
- to understand and identify gaps in the postharvest chains to design; and
- to define the opportunities for Jordan and design scope of work for HAED Project interventions to build on these opportunities.

1.3 Content of the report

Chapter 2 introduces the approach of this study with regard to the data collection, the data analyses and the suggestions for opportunity embedding within HAED

This project focuses on postharvest systems in Jordan. In order to evaluate existing systems, introduce gaps and suggest opportunities within HAED, general market information and background on Jordan's competitiveness as a country is required. Therefore, chapter 3 starts with an overview on these topics in section 3.1. Secondly, the existing postharvest systems are described per category in section 3.3. Section 3.4 contains the gap analyses of existing postharvest systems.

Chapter 4 introduces the approach that the HAED team is suggesting. The authors of this report share their recommendations towards it in section 4.2. Section 4.3 discusses recommendations for inclusion within the HAED project.

2 Approach

This approach of this fact-finding mission is structured in three sections:

1) Data collection
2) Data analyses
3) Opportunity embedding within HAED

Most of the data is collected during the 4-day visit to Jordan. Visits to different farms and postharvest facilities are performed, unstructured interviews are held, stakeholders were consulted and a workshop with multiple stakeholders was organized in Amman.
Additionally, data is collected by a review on the baselines reports prepared by Eco Consult. In addition, literature on postharvest systems in Jordan is studied.

The data analyses were executed by the authors and are based on comparisons with multiple postharvest systems worldwide and their evolution over time. Special attention during these comparisons was given to hardware utilization, governance structures and potential markets. The data analyses result in gap analyses.

In gap analyses, the sky can be the limit. Therefore, suggestions for opportunity embedding within HAED included in the method.

3 Results

3.1 Important markets and Jordan's competitiveness

This section presents general market information of the Jordan valley and the Jordan highlands. Additionally, background information is given on Jordan's competitiveness as a country.

3.1.1 Potential markets for the Jordan valley

Potential markets for Jordan vegetable exports include the Gulf, Russia and South East Europe. However, also Iraq and Syria should not be excluded as these countries were important export destinations until recently and once the war in Syria comes to an end, Syria and transport through Syria are likely to become important again.
For now however, Syria is closed and market share in Iraq needs to be recovered.

Russia:
Russia seems very interested in importing fresh vegetables from Jordan in the winter period (October to April). This is exactly the period of the Jordan valley production window.
The main market would be Moscow. This area is likely to be able to consume a large part of the JV production if not all. For political reasons, import of fresh vegetables from Spain is currently blocked as it falls under a general boycott of several EU products. This is a competitive advantage for Jordan enabling the country to gain market share and position itself in a strong position before the Russian market possibly would open again for EU (Spanish) fresh vegetables in the future.
There is a competitive disadvantage with Turkish exporters who have established relations, less transport time and transport costs and who receive export subsidies from their government in the range of US$ 50 to US$ 80 per ton vegetables.

Before the Syrian war, already large volumes of vegetables were exported by Jordan to Russia but back then, this trade was controlled by Turkish middlemen who transported the vegetables and sold them to their Russian contacts. The advantage for Jordan exporters was that they faced hardly any payment risks. The disadvantage was that they received a relative low price for their produce due to a margin taken by the Turkish middlemen.

The Syrian war made this export flow to Russia by truck/road collapse. Having a big impact on Jordan producers, especially in Jordan valley.
Some export to Russia is already restarted but the route now is by sea. This has some mayor implications, both good and bad.
The good thing is the fact that the situation forced the Jordan exporters to work without the middlemen in this market, thus shortening the chain and increasing the potential farm-gate price.
The bad thing is an increased risk. Relations with traders in Russia need to be built and due to the route via sea, taking 2 weeks, several containers of produce are under way before the first one is being paid after receipt. This situation is much more difficult to control than transport by truck due to transport time (7 days by truck) and possibility to change destination, which is easier when sent by truck.
Another issue is the long transportation time via Haifa (via Aqaba seems much more complicated still and the route takes longer). The shelf life (the period that the product remains fresh to an acceptable level) needs to be extended as much as possible in order to minimise quality risks at arrival (and payment risks related to that). Management of the cold chain is a challenge and emphasis on good management and pre-cooling that needs to be available close to the producer areas becomes very important.

Like other main potential markets for Jordan vegetables, MRLs (Maximum Residue Levels) must be strictly complied with or they could form a risk for both the exporter as his shipment may be rejected, as well as for the country as import may be restricted. Testing for MRL-levels before shipment can and

must be done. Working towards prevention is necessary (implementation of certification schemes for primary production and packing).

Main conclusion is that the Russian market is highly potential. Finding reliable partners (importers) is a key issue that must be invested in.

South East Europe

When the European market is considered, a distinction should be made between North-West Europe and South-East Europe. One is distance, but the other main difference is the purchase power of importers. In North-West Europe, the supermarkets' share in fruit and vegetables (F&V) sales is close to or over 90%, giving the supermarkets purchasing power and a need for large volumes (of the main products like e.g. tomatoes). They prefer to buy these products from suppliers that have the capacity to offer consistency in quantity and quality in large volumes and preferably are able to offer a wide range of F&V. This has resulted in the formation of second tier marketing cooperatives (a cooperative of cooperatives) to be able to meet the demands.

In South-East Europe, the opportunities for Jordanian exporters are better. Usually more than 60% of F&V are sold via street markets and vegetable shops, resulting in a less purchasing power for the importers.

Romania, Bulgaria and Hungary are main markets with potential for Jordan produce.

As with Russia, the transport needs to be arranged via Haifa by sea and therefor the same issues are valid for this market than described for the Russian market.

Especially capsicums are currently already being exported to Hungary. As these are a special type of capsicum that cannot be sold on the Jordanian market, the production must be planned beforehand and contracted with farmers.

Domestic market

The domestic market is a destination for Jordan Valley produce. Currently, all sales need to be through the wholesale market by law. As most farmers produce at the same time (push market), prices are mostly low, packing is minimal and the cold chain is not respected.

For exporters, the domestic market is important as an outlet for their 'non- exportable' class products. An opportunity for Jordan valley would be to cooperate with supermarket chains in a short value chain that focusses on communication, supplying according to the requirements in terms of type, packing, consistency, quality and quantities.

Supermarkets do have problems with the supply of their fresh produce and are interested in cooperation in value chains with progressive producers. There are some legal issues however to be solved and the market share of Supermarket chains in fruits & vegetables is limited in Jordan.

The Gulf (UAE, KSA, Kuwait, Bahrain)

The Gulf is a large market for fruits and vegetables.

The market window is mainly from April to November, a period that does not coincide with the production window of Jordan Valley. There is lots of competition on the Gulf market from all over the world and there are large projects underway in UAE and KSA mainly, that focus on an increased self-sufficiency in fresh vegetables.

Large amounts of fruits are being exported from Jordan to the Gulf, but for vegetables from Jordan valley, this market is less interesting.

3.1.2 Potential markets for the Jordan highlands

For the winter production, markets like Russia and South East Europe are a possibility. The main summer production window coincides with the main Gulf market window.

Gulf

The Gulf (UAE, KSA, Bahrain, Kuwait) form a huge market for fresh fruits and vegetables and an important destination for fruits from the highlands in Jordan. Transport takes 2 to 3 days by refrigerated truck.

For vegetables, the situation is not fully clear. The Gulf market is significant and continues to grow. Some sources say that Jordan is the third supplier of vegetables (tomatoes) after Egypt and India for

both, Gulf and KSA. Other sources state that export to this region cannot by far compensate for the loss of market in Syria and Iraq. An interviewed exporter in Jordan Valley estimates that currently Jordan exports some 25 trucks of vegetables per day to KSA and UAE, compared to 60 trucks per day to Syria plus 100 trucks per day to Iraq before the war.

Still the Gulf market for Jordanian vegetables is considerable.

Table 1: Jordan fresh veg. exp. destinations

Jordan export of fresh vegetables (x € 1,000) importing countries	2011	2012	2013	2014	2015
world	**433,082**	**355,307**	**358,406**	**457,083**	**474,847**
UAE	53,889	68,088	69,493	85,650	95,730
KSA	941	14,921	52,070	62,189	89,775
Kuwait	23,375	34,824	47,976	64,626	83,542
Qatar	19,765	29,204	34,383	44,087	59,956
Bahrain	11,680	17,680	17,799	25,850	29,442
Oman	9,348	12,128	13,697	19,528	23,705
GULF	**118,998**	**176,845**	**235,418**	**301,930**	**382,150**
Syria	82,433	83,556	38,549	55,767	33,192
Israel	6,994	10,067	17,137	10,293	21,000
Iraq	76,122	31,192	43,139	67,422	16,371
Romania	12,437	8,871	2,307	1,006	705
Russia	13,901	14,061	1,953	589	71
Hungary	4,186	4,103	3,739	1,986	12
Bulgaria	2,715	1,577	27	0	0
EASTERN EUROPE	**33,239**	**28,612**	**8,026**	**3,581**	**788**

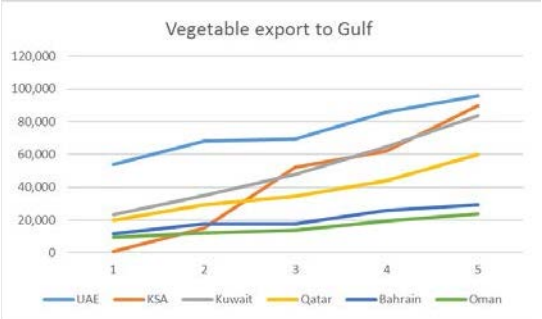

Figure 1: vegetable export to Gulf[1]

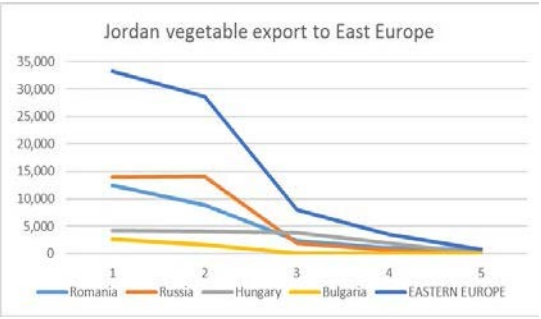

Figure 2: Jordan vegetable export to East Europe[2]

There are some issues to consider in the KSA/Gulf market:

- The distance is limited and export can be done by truck
- There is a common culture /language that makes communication easy
- There is much competition from all over the world on the Gulf market
- There are large projects underway in KSA and UAE to increase local greenhouse vegetable production
- Jordan produce is marketed for a lower price than the same quality from e.g. Holland or Spain (image)
- Transfer at the KSA border is time consuming and breaks the cold chain
- There have been political tensions in the past that resulted in a closure of the border with KSA
- Most Jordan vegetables are sold via Wholesale marketing channels that are not very transparent and squeeze the sales price.

It should be noted that for niche products like strawberries or cherry tomatoes, there are good opportunities during certain (short) market windows in the Gulf.

[1] Leeters J. (2016), "Export Value Chain Analysis Fruit and Vegetables Jordan", RVO

[2] Leeters J. (2016), "Export Value Chain Analysis Fruit and Vegetables Jordan", RVO

Some of these issues lead to the conclusion that the Gulf is an important export destination for the highlands but there are many issues that need to be improved as a sector, to remain competitive in this market or to add value by developing improved marketing channels.

Control of MRLs and a change towards a prevention system is important for this market as well.

Syria / Iraq
In the short term, Iraq is a potential market for vegetables in from the highlands. Especially in the summer period, when it gets too hot in the Basra area in southern Iraq, vegetables form the highlands have an opportunity. The market seems to open up and transportation is once again possible.
In the mid-term, also Syria may be expected to become a promising destination again for highland (and especially Jordan Valley) vegetables. The market is nearby, cheap in transport and not very demanding. It can be easily and competitively supplied from Jordan once the situation normalises which may be expected to occur over the next few years.

3.1.3 Country competitiveness & policies

Jordan's geographic location and climate as well as land and water availability and policies gives the country's fresh vegetable sector some competitive advantages as well as disadvantages.

Advantages:

- For the KSA- and Gulf markets, Jordan has the advantage of relative proximity enabling the supply by refrigerated truck in approximately 2 to 3 days, which is a logistical advantage, and a (transport) cost advantage, especially compared to competition from e.g. Turkey.
- In the winter season, Russia demands large amounts of fresh vegetables. Spain, the main supplier is far away and currently blocked from supplying Russia due to boycott.
- The Russian market can be reached by truck again once the Syrian war is over (2 years?) This is slightly cheaper than sea transport via Haifa but much easier to manage and faster.
- Production figures of yield per m^2 are quite good for tomato and capsicum.
- Production in winter can be realised without heating.
- The Syrian war forces Jordan exporters to shorten the chain and do direct business in Russia, rather than selling relatively cheap to Turkish middlemen.

Disadvantages:

- Transfer of fresh vegetables to UAE by truck needs to pass through KSA and at the KSA border the breaking of the cold chain forms an obstacle. This needs a political solution though and politics are somewhat unpredictable in the region.
- No direct access to the Mediterranean for reefer transport to Russia /East Europe. Reloading at Israeli border and shipment via Haifa.
- The Aqaba harbour facilities and sea line services are not well organised. Sea routes via Aqaba to Russia are not well developed and take more time due to passage through Suez Canal.
- Irrigation water is expensive and the quality is not optimal (EC_w-levels). In addition, the availability is not unlimited as Jordan already uses more water than is naturally replenished.
- Labour is in short supply.
- The recently newly introduced 10% VAT on agricultural inputs increase the cost price.
- There is no government support for export of fresh vegetables. (e.g. competitor Turkey gives US$ 50 to $ 80 per ton direct support to its vegetable exporters)
- There is a law that forces farmers to supply supermarkets via wholesale markets
- The bulk of the production is not certified (GlobalGap) and only receives a test result for MRLs prior to shipment. In this regard, the sector lags behind countries like Holland and Spain that even already made the move towards IPM systems in greenhouse production.
- There are hardly any pre-cooling facilities available in the producer areas, especially in Jordan Valley
- If temperatures are low in winter for some weeks, the production of thermophile vegetables like tomato and capsicum drops immediately during this period.

- The image of Jordan vegetables result in lower sales prices abroad than comparable quality vegetables from some other countries
- There is a lack of a reliable network of buyers, especially in Russia

The Jordan vegetable export sector has good prospects but there are several points of attention that need to be addressed.

- Improved hydroponic systems can further increase yields, leading to lowering production cost price.
- There is an urgent need for certification in order to structurally tackle the MRL issue
- There is a need to improve the image of Jordan vegetables through consistency of supply and certification.
- Especially the ending of the war in Iraq and Syria will improve the export prospects as the route by truck to Russia will be opened again. Apart from that, both countries potential export destinations like they were before. (Syria with focus on the winter season, Iraq with focus on the summer season).

3.2 Summary of postharvest systems in Jordan

This section presents an overview of existing postharvest facilities in Jordan including the main exported products and markets. The overview is created by HAED team members based on the 4–day mission and prior work.

Table 2: Jordan Valley Postharvest Facilities[3]

Postharvest Facilities Name	Area of facility m^2	Export 2017 ton/y	Exported Products	Main Markets	Export Certificate	Cold Storage (Freon gas)		Pre-cooling (Freon gas)		Working Area		Postharvest Equipment
						No.	Total Capacity	No.	Total Capacity	No.	Total Capacity	
Agri-Jordan	900	510	Broccoli, herbs, sugar snap, hot pepper	UK, Gulf, Local Market (WSM),	Leaf, Tesco, PRC, Global Gap, Sedix, Fire System	4	100 ton	1	160 m^3	1	600 m^2	Capsicums Washing, drying Grading, weighing Line Machine
Phoenix Agricultural production co. (DAMCO previous)	4000	500	Broccoli, Sugar Snap, peas, tomato	UK (Tesco, Waitrose), France, Jordan Supermarket	Tesco Nature choice, Global Gap, BRC, GSF, FTF	4	250 ton	4	440 m^3	2	2000 m^2	Complete fresh fruit processing (cutting) line. 4 Conveyer-belt machines
Jordan Agricultural Produce Promotion Co. (JAPPCO)	1500	400-500	Broccoli, Fresno Chilies, Tomato ,Capsicums, and Baby Cucumbers	Ireland, Jordan Supermarket	Tesco Nature choice, Global Gap, BRC, ETI, LEAF	4	100 ton	1	440 m^3	1	1000 m^2	4 Stainless Steel Tables

[3] Souce: HAED

MOH'D ABU SEEDO EST.	1500	2500 veg 300 fruit	Capsicum, Tomato, Cucumber, Squash, Okra	Russia, Saudi Market	Non	1	50 ton	-	-	1	1500 m^2	Conveyer machine, Pallet Stretch Wrapping Machine
Ra'ed Alhamshari trading EST	1200	10,000	Tomatoes, cucumber, pepper, Squash, eggplant, cauliflower	Gulf area, Russia, Israel	Non	2	70 ton	-	-	1	1000 m^2	Sorting tables
Zahrat Al Wadi (Mohammad Hijazi)	3000	1000	lettuce, pepper tomato, cucumber, strawberry	Qatar, UAE, Saudi, Russia	Non	2	60 ton	-	-	2	2600 m^2	Conveyer machine Pallet Stretch Wrap Machine

Table 3: wholesale market facilities[4]

Postharvest Facilities Name	Area of facility m^2	Export 2017 ton/y	Exported Products	Main Markets	Export Certificate	Cold Storage (NH3 gas)		Pre-cooling (NH3 gas)		Working Area		Postharvest Equipment
						No.	Total Capacity	No.	Total Capacity	No.	Total Capacity	
Abu Jabeer logistics Company	16,300	5000 ton fruit, 3000 ton vegetable	Fruit and Tomato, Pepper, Cauliflower, Squash	UAE, Saudi, Oman, and Kuwait, Local Market	ISO 22000, HACCAP	59	24,000 ton	2	1200 m^3	2	4300 m^2	None
A&M Sultan for fruit and Vegetable Company	5,000	7000 - 8000 ton	Fruit and Tomato, Pepper	Qatar, Bahrain, Dubai, Saudi, Kuwait and Russia	Fire System	44	3,200 ton	2	864 m^3	2	3000 m^2	Automatic Washing, drying Sorting machine based on Colour, Size and Weight, & Cartoon Box Conveyer machine
Taj Cooling Company	5000	17,000 ton	fruit, Tomato and pepper	Saudi, Iraq, Egypt, and Russia	Fire System	5	1000 ton	3	2000 m^3	2	2700 m^2	Half Automatic Washing, Brushing, wiping, drying, waxing, 4 conveyer for packing machine
Darb for trading & Refrigeration L.L.C	35,000	200-400 ton daily, or (30,000	Fruit, tomato, cucumber, pepper	UAE, Saudi, Oman, and Egypt,	ISO 22000, HACCAP	92	17,000 ton	1	750 m^3	3	8,000 m^2	Automatic Washing, waxing, drying, and sorting by weight and colour)

[4] Souce: HAED

		- 35,000 ton/year		Jordan Supermarket								
Hammodah Son Company	6,700	28,000 ton	fruit, Tomato, lettuce	UAE, Saudi, Qatar, Bahrain, Local Market	Fire System	13	2700 ton	1	360 m^3	2	1,200 m^2	Automatic Washing, drying Sorting machine based on Colour, Size
Fresh Fruits Co	120,000	400 ton daily	Fruit, tomato, lettuce pepper	Russia & Ukraine, Gulf Arab Countries	ISO 22000 + HACCAP Fire System	126	74,000 m3	4	1760 m^3	2	3,500 m^2	Automatic Washing, waxing, drying, and sorting by weight and colour), 14 packing lines
Samih Alrajabi suns Co	-	-	All kind of Veg and Fruits	Qatar, Saudi, Kuwait, Oman, Bahrain, UAE	Under construction	14	1000	1	-	1	-	Under Construction

3.3 Categorizing postharvest systems

Paragraph 3.2 summarizes the existing postharvest systems in Jordan. The nature and challenges of the postharvest systems observed cannot be put under one umbrella. Therefore, three observed categories are listed in section 3.3.1. It is expected that during the selection of stakeholders for continuation of the HAED project, the categories will become a selection criteria. The gaps are introduced in Table 4, but described in detail in section 3.4.

Laboratory testing for MRLs is relevant for all categories and therefore listed in a separate section: 3.3.2.

3.3.1 Three categories of postharvest systems

During the 4-day mission to Jordan, many stakeholders have been consulted. The authors have to category them for further analyses. Three observed postharvest categories are shown in Table 4 and described below. References to gaps (section 3.4) are shown in Table 4 only.

Table 4: Three categories of postharvest systems

	Small to medium sized farmer (groups)	Medium farmers facilitating niche export markets	Large farmers / buying organization with effective (export) facilities	Gap# / section
Push / pull	Push to WSM	Mostly pull	Mostly pull	Gap1, 3.4.1
Knowledge on quality	Until farm gate	Up to export consumer	Up to export consumer	Gap2, 3.4.2
Pre-cooling	Limited	Available	Mostly available	Gap3, 3.4.3
Cold rooms	Limited Available	Available	Available	No gap
Packaging	Available or easy to implement	Available or easy to implement	Available or easy to implement	No significant gap
Image/ brand	No brand building	Export brand	Variable	Gap4, 3.4.4
Global gap	Very limited	Implemented	Mostly implemented, some exceptions	Gap5, 3.4.5
Ambition to change governance structures	Yes, for market access	Limited	Yes, to improve facility utilization	Gap6, 3.4.6

Category 1: Small to medium sized farmer (groups)
The majority of farmers consulted can be categorized in this category. Generally, push production is executed and produce is (indirectly) sold to the wholesale market (WSM) or traders collecting locally. The knowledge on quality limits to whatever is visible for the farmer (production up to farm gate). Knowledge on quality, or opportunities to improve quality, after farm gate (e.g. at WSM, consumer level) is usually limited. Cold rooms are available to some extend but pre-cooling (effect on quality: post farm gate) is absent. Effective packaging is either present of easy to implement with local or cost-effective imports. This differs per product though. For example, bell pepper and tomato would benefit from mechanised grading and colour sorting whereas iceberg lettuce or broccoli can easily be graded and packed by hand. No activities with regard to brand building were observed. Global Gap implementation is mostly absent but farmers are motivated to participate in new governance structures if this improves market access.

Category 2: Medium farmers facilitating niche export markets
A couple of medium sized farmers are producing for niche export markets (e.g. strawberry to the United Kingdom or Gulf) only. Therefore, production is pull oriented. Regarding the specific product niche, their knowledge on quality is relatively high and quality awareness is present up to consumer level. Both cold storage and pre-cooling are up to export standards but could use some improvement to meet more modern standards. Effective packaging is present. GlobalGap is a prerequisite of their

customers and has been effectively implemented. The farmers own a well-established brand that is known within their niche. This category of farmers has none or limited ambition to realize new governance structures.

Category 3: Large farmers / buying organization with effective (export) facilities
The larger farmers that were consulted have, almost without exception, additional business as a trader. Usually as buyer from other Jordan farmers, but also as importer. Own production as well as buying produce of other is based on market demand (pull). Their knowledge on quality is relatively high and quality awareness is present up to consumer level. Most large farmers or large buyers have pre-cooling facilities. Exceptions observed regard products that face less impact on quality like capsicum to short distance markets. All stakeholders have cold rooms available. Effective packaging is present. Most of the farmers own a brand and value global gap as a tool to link their brand to high quality. Some, not all, of these larger players show interest in the setup of new governance structures, especially with regard to smallholder farmers that currently lack a profitable market. The interest is born from an additional business perspective or an opportunity to improve utilization of existing cold storage and packaging facilities.

3.3.2 Laboratory testing for MRLs

In all markets discussed as potential export destinations for Jordanian fresh vegetables, Maximum Residue Levels (MRLs) are an important issue. The MRLs may differ somewhat per country but produce is being checked (randomly) for MRLs at arrival by state institutions. Food safety is the reason to check vegetables for MRLs.
Some chemicals are not allowed at all for crop protection of certain vegetables whereas others are (crop specific) allowed but there are rules regarding amount of substance that can be used as well as waiting times in number of days after an application before the crop can be harvested. The combination of chemical substance, concentration and waiting time, results in a residue level.

In Jordan, all stakeholders consulted were aware of the import ban for several fresh vegetable types that was imposed by UAE last year. The sector is well aware of the importance of MRLs. The MoA has invested in modern, high quality testing equipment and testing for MRLs is required for each truck before the fresh vegetables are allowed to be exported. There are several laboratories in Amman (private and under MoA) that are able to conduct these tests in a very professional way and are able to detect a wide range of chemical substances in very low concentrations. These labs are accredited by the destination countries (e.g. UAE) and the private lab is accredited by the Jordanian MoA. MoA inspectors take the samples at the premises of the exporters and bring these to a laboratory. The tests themselves take approximately 1½ hours but occasionally, if many trucks need to be tested, it can take up to 2 days maximum before the test is conducted. The exporters need to wait until the certificate has been issued before they can leave.

The focus of MoA, farmers, buyers and exporters, with regard to MRL tests, is in on controlling potential risks after production. A focus on prevention of exceeding MRLs seems lacking. In theory that could make MRL tests needless. This gap is discussed in more detail in section 3.4.5.

3.4 Gap Analyses

This section shows 6 identified gaps. The advice of the authors whether to embed in HAED is discussed later (chapter 4)

3.4.1 Gap 1: Limited pull production (chicken egg-dilemma)

The vegetable sector in Jordan is still mostly a push chain. Farmers produce and afterwards try to sell. Only some exporters apply a model in which they know to whom they will sell and what are the requirements of the buyer, before they plan the production.

The bulk of the product is sent to wholesale markets in Amman or exported to wholesale markets in for example Jeddah, Riyadh or Dubai. Often the supply does not fully meet the demand, resulting in low prices and food losses. In addition, the opportunities for the creation of added value are limited.

Figure 3 shows the concept of push and pull chains.

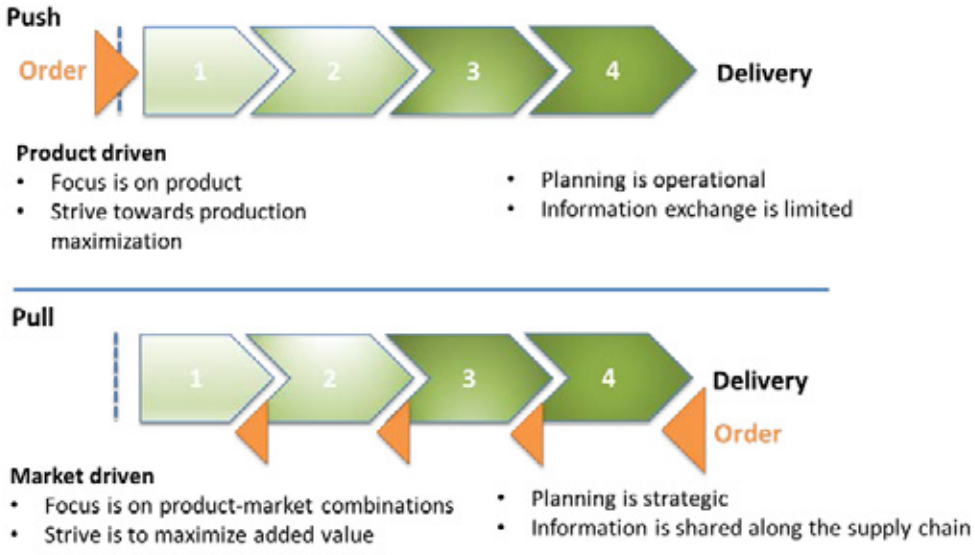

Figure 3: push versus pull supply chains[5]

Many producers and exporters realize that a shift to pull chains is an opportunity. On the other hand, these stakeholders experience to suffer from a chicken-egg dilemma with regard to investments:

- Find a market first, that will request an upgraded (pull) supply chain
- Upgrade the supply chain first, that requires a profitable market to gain return on investment

So the gap to fill is a shift from push to pull market that reduces food losses, gives more fruitful returns on investment and enables farmers to create more added value.

3.4.2 Gap 2: Knowledge on quality

From the moment of harvest, the fresh product is subject to loss of quality. Therefore, the initial quality on the moment of harvest is crucial, because quality cannot be improved, it can only deteriorate. In the figure below one can see the quality decay of a product in an original chain (orange line).

The challenge of post-harvest quality management is to keep the quality as high as possible. Knowledge on how to do that is crucial. However, in many cases it can be observed that there is a lack of knowledge on post-harvest management.

It is important to understand that the initial quality should be a high a possible. Secondly, all kind of technologies and treatments can be applied to slow down the quality decay, like temperature & humidity control, specific atmospheric treatment (like reduced oxygen), packaging etc. The blue line shows the quality decay of the supply chain with improved measurements for quality control.

The business case of post-harvest management is threefold:

- License to deliver: sometimes clients demand certain quality guarantees for delivery, for example GlobalGAP certificates, which includes quality standards;
- Better quality at a certain time in case the client wants to reward that quality difference;
- Additional time at the same quality level: this offers new possibilities for further markets.

In Figure 4, the quality decay is shown schematically.

[5] Wageningen Food & Biobased Research, PowerPoint presentation on Smart Agri-food Supply Chains, 2017.

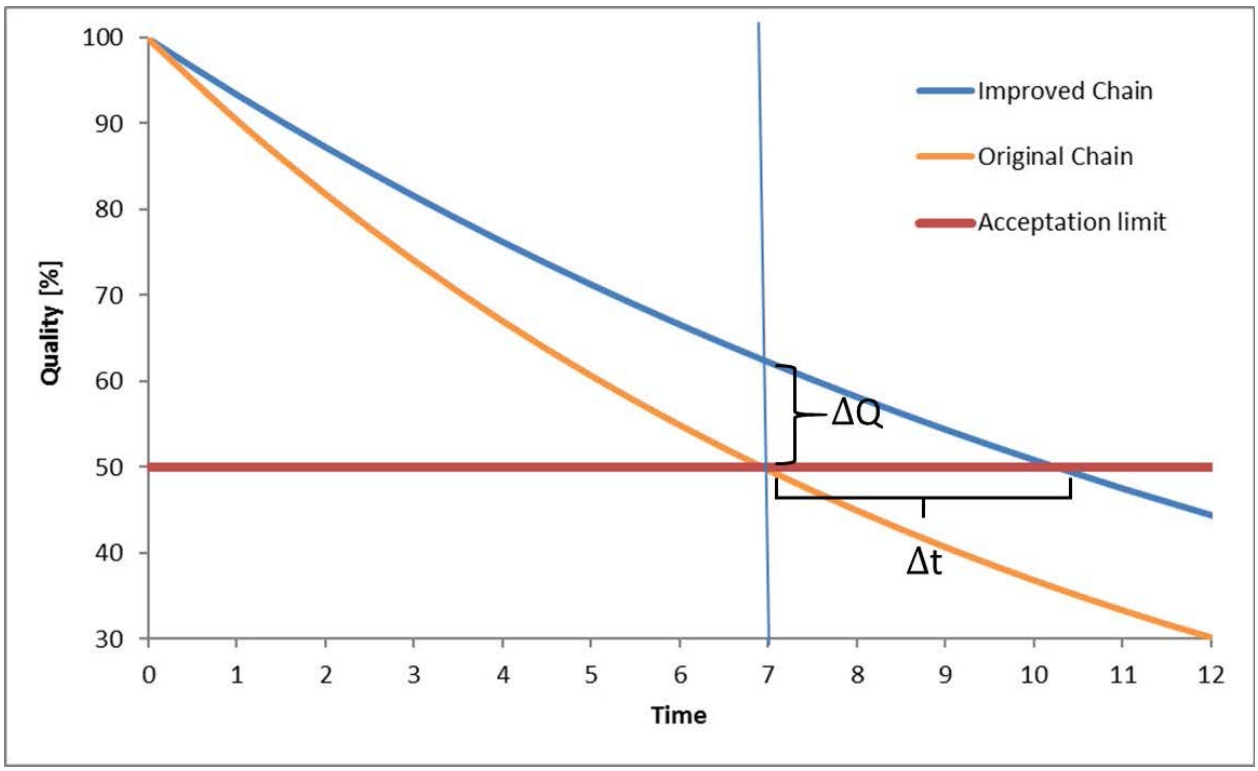

Figure 4: Example of a Quality models to show the effects of an improve chain in quality at a certain time (ΔQ) or in additional time at the same quality ((ΔT).

With regard to Jordan, export of vegetables is key to the further development of the sector as Jordan Valley has a competitive advantage during their harvest seasons and export is needed to sell surplus production and achieve better prices.
The export market is an international environment where competition by many other countries occurs. In this regard, Jordan is forced to perform as good or better than the competition. Knowledge at all levels in the chain is an important aspect to achieve good performance.

The knowledge gap can be categorised in different aspects of quality:
First, currently there seems to be a lack of knowledge at farmer level on crop-protection chemical use and overall GlobalGap implementation. This issue urgently needs to be addressed in relation to the export markets as consumers demand GAP and food safety and MRL issues cannot be solved by only checking via laboratory analysis.

A second aspect of quality relates to freshness and shelf life. There is a lack of knowledge in Jordan, especially with the smaller farmers, on the effects of handling, time-management, temperature management, packing material and transport conditions on maintaining the quality of vegetables from the point of harvest to presenting them in the (super) market.

A third aspect of quality is meeting customers' expectations. Apart from freshness, this concerns presentation, colour, size and taste of the vegetables. This is information that comes from feedback from the market, trough exporters and/or market research. However, in practice only those exporters that operate in long-term fixed supply chains actually communicate this information to the farmers.
Some information regarding colours, size and taste is also being provided by seed companies that know market requirements and offer varieties matching these.

Sometimes, a better quality results in a higher price, but not always. However, products that are being rejected at an export market due to an exceeding MRL or because the freshness is not sufficient, certainly lead to a loss. From this perspective, there is no other option that to improve quality (and improve the knowledge level on quality).

An example in an international context is the implementation of GlobalGap. Vegetables do not get a better price when they are GlobalGap certified. Farmers tend to resist implementation at first because

they consider it a cost. Farmer cooperatives involved in the marketing usually offered a small premium for their members' products when GlobalGap certified and stopped paying tis premium after 1 or 2 years. The option on many markets just was to either certify or lose the market but usually the sales organisation realises this better than the farmer does.

Apart from knowledge, also awareness is therefore important. Farmers, packers and shippers must be aware of the effect of their handling on the final quality upon arrival.

Seed companies are represented in Jordan and they test their varieties under local production circumstances. Knowledge on vegetable production is widely available but there are some countries that have more advanced production (and marketing) systems and therefor it is advisable to participate in study tours every now and then like several producers/exporters already do to keep up to date.

In the case of Jordan, its competitors on all potential export markets have all already invested in grading- and packing lines and pre-cooling is common. The advice for Jordan is to invest in upgrading the supply chain but keep it within limits.
The capacities for pre-cooling and room cooling in case of fresh vegetable export do not need to be very large as they only need to cover the amounts that can be exported within the next (few) day(s). With pre-cooling the risks of non- or reduced payment due to quality problems can significantly be limited.
Exporters indicate that complains they receive are not so much about quality of the produce. It rather concerns packing and grading.
A grading- and packing line, including colour sorting for tomato and paprika, will result in more satisfied customers, save on labour costs, makes management easier and is likely to return its investment quite fast.

An export model consisting of an exporter with a fixed number of suppliers is easy to copy, because many alike producers exist. It can used as an example of sector development.
Advice on farmer level regarding GlobalGap implementation (including the MRL issue) is a gap to fill regarding knowledge on quality, but will be discussed in section 3.4.5 as an individual gap.

The exporter should be provided training on handling, time-management, temperature management, packing material and transport conditions. Training on handling and temperature measurement should also be provided to the supplying farmers. With emphasis on awareness.

A structured communication must be established with clients in the export market with pro-active seeking feedback on quality in all its aspects. The outcome must be translated into next season's planning with farmers and pack station and may include variety choice, planting distance, harvest method, post-harvest logistics, pack-house handing, cold-chain settings etc.

Temperature loggers must be placed in any shipment to check conditions during transport and to be able to improve transport conditions based on registered data. In addition, the product should at certain intervals be followed by loggers from moment of harvest to loading. Data should be analysed and lead to improvement in the postharvest logistics.

3.4.3 Gap 3: Limited pre-cooling

There is a big difference in the intended use of cold store facilities. Different use leads to different design- and capacity requirements.
In the case one wants to store a product at harvest time with the aim to gradually sell it or sell it in a period when prices are higher, the storage is intended for long-term conditioning of the product and large storage capacities are needed.

In the case of export or direct marketing of fresh produce, the aim should be to limit the capacity of the cold storage rooms to the amount that will be sold in one or two days (Until the next truck

leaves). The focus in this case is to cool the product to its optimum storage temperature (+ RH) in as short as possible time after harvest.
This is realised by a combination of:

- planning (harvest time, transport);
- distance between farm and cooling facility (cold storage in the producer area); and
- choice for pre-cooling.

Pre-cooling is aimed at reducing the product temperature very fast up to the centre of the product. Whereas this may take up to 24 hours when a product is put in room cooling, it may take only 20 minutes when pre-cooling.

We observed a limited number of pre-cooling facilities in Jordan. Especially for strawberries. The main type of pre-cooling system in use was forced air. A system in which cold air is actively drawn through the boxes and product.
This system is very well suited for a wide range of products, including tomato, capsicum, strawberry, iceberg or broccoli.

Each product has a maximum shelf life. The length of this shelf life very much dependents on the handling and storage conditions. One of the factors that has a major impact on the shelf life is pre-cooling.
Especially in the case that transport to the export destination takes much time, the risk increases that the product is at the end of its shelf life at arrival. In these cases the conditioning and especially pre-cooling becomes very important.

In order to fill this gap, relative small but commercial size and efficient pre-cooling should be installed at (a) pilot project(s). Training should create awareness with farmers of the importance of pre-cooling. This should preferable be done by comparing the difference between pre-cooled produce and produce that was only put in a cold room by simulating the storage and transport conditions until final destination. By using loggers, awareness will be created among farmers and pack station management on the effect on the product until final destination. This is important, because usually these supply chain actors loose visibility of the product after loading.

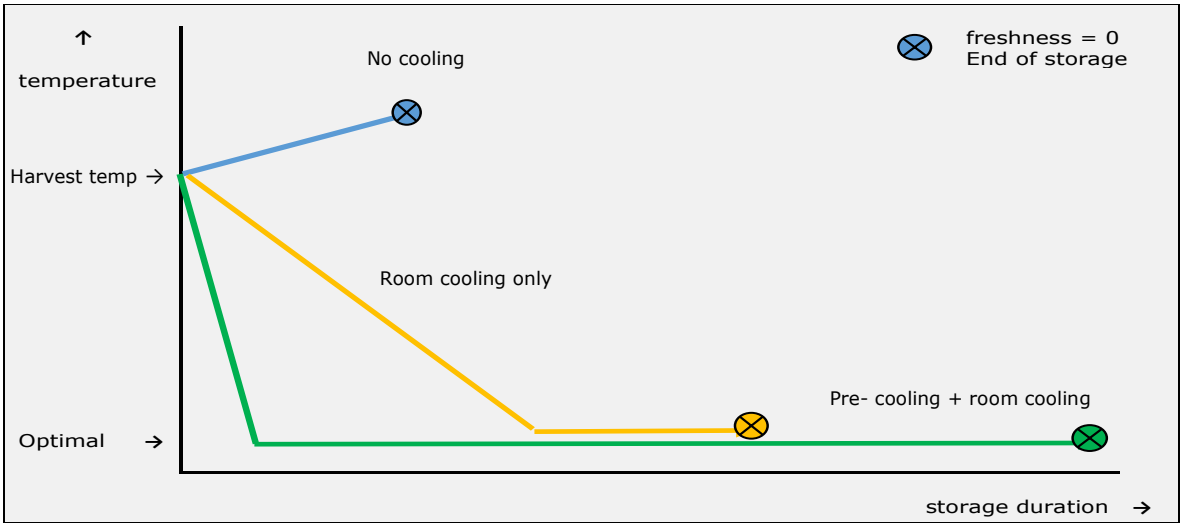

Figure 5: Influence of pre-cooling on shelf life

The effects as indicated in the above graph should be made visible via the test as described above in order to create awareness with farmers and pack house staff and to collect product specific data.

3.4.4 Gap 4: Image of Jordan Produce / No international value to Jordan produce

Image is an issue that needs time to adapt. Buyers must become convinced of quality and this can be realised over time by working on consistency. The customer should get what he expects and not be disappointed. This in term involves many different angles.

The quality of products in one truckload, coming from different farmers must be the same (variety, sizing, colour, etc.). The quality should be good during the whole season. MRL issues and bad publicity are disastrous for the whole sector (not only for the exporter or farmer involved).
Knowing the farmers, planning before the season starts with regard to variety choice and cultivation practices, certification of farmers to build trust in the product are examples of issues that need to be addressed (for this the system of purchases via the wholesale market needs to change).

Good sorting and a nice presentation (packing) help to build trust and image.
Strict quality classification and consistency in the supply of this quality help to build trust.

Improving the image of Jordan vegetables takes time and a lot of effort and still the whole sector may be at risk if only a few farmers or exporters spoil it by supplying products that do not meet expectations.

Individual farmers, farmer groups/ exporters do have the possibility to improve their image as well on company level and thus can achieve better prices. The same issues as mentioned above apply but apart from that, the product must be recognisable (trade name/label/marketing).

Once one puts its company name and logo on the product, it becomes extremely important to be very strict in your quality procedures because a bad product will spoil your image faster than a good product will build trust.
However, improving quality, consistency, grading and packing at company level is the best way forward and makes the company less dependent on the actions of others. Initiatives for image improvement on country level may follow later.
Pre-cooling should be mentioned separately as a means to improve quality and therewith improve image. Pre-cooling has a direct relation with shelf life.

To fill this gap, building a good relation with the client in the export market is required. Consistency is the main focus in image building. As Jordan seems to have a positive sound in Russia according to exporter's feedback, this origin should be well visible on the box.
In order to realise consistency (in quality, supply, appearance, taste etc.) a good joint planning (pack-house and supplying farmers) is needed, including varieties, cultivation method, planting/ harvest planning. Strick rules for quality management in the pack station and final check before shipment are needed.

3.4.5 Gap 5: No GlobalGap certification

Gap 2 (3.4.2) already discussed GlobalGap as an important consideration or tool with regard to knowledge on quality. A lack of it should be considered as a gap on its own though.

Testing MRLs before export is a good thing, but the next level must be to prevent MRLs exceedance. Prevention is best done via implementation of certification schemes in primary production (e.g. GlobalGap).

It is therefore strongly recommended for the Jordanian vegetable sector to stimulate the implementation of GlobalGap (or comparable). Implementing a certification scheme consists of 2 parts that should be done by different companies. One is consultancy, helping farmers to set up the system and implement it on their farm in a technical and organisational manner. The other part is the audit to verify if the system was implemented correctly.

A limited number of primary producers in Jordan is currently GlobalGap certified (and/or BRC). The numbers are not sufficient for an auditing company like SGS to have its own auditor for GlobalGap operating from Jordan. For implementation, this is however no problem as SGS auditors can be arranged to come from Egypt of India to do the auditing if so required.

There already seems to exist a program under responsibility of the Jordanian MoA, that tests GlobalGap certified companies randomly and issues export certificates (free of MRLs) without testing

each truck or shipment. This way of working has the potential to significantly improve efficiency in export logistics.

To fill this gap, the farmers cooperating in a pilot and supplying to the exporter should willing to implement GlobalGap as a pre-requisite to participate as a supplier. Most likely it will be possible to certify them as a group, provided there is some formal cooperation structure and an internal auditing system organised by the group. This will save on certification costs.

As said, it should be noted that GlobalGap, even when not demanded by the client, is an efficient management system that helps farmers to avoid mistakes.

3.4.6 Gap 6: Governance structures to facilitate continuous improvements

On the next page, Figure 6 shows nine frequently observed governance structures worldwide. This figure also shows the complexity and 6 key elements that frequently go hand-in-hand with these governance structures.

In Jordan, 7 out of 9 governance structures were observed (Table 5.)

Table 5: observed governance structures

Observed governance structures	Not observed governance structures
Independent smallholder farmer (SHF)	Farmer cooperation (formal, with marketing body)
Independent medium farmer (without marketing body)	Cooperation of cooperatives
Buyer - Farmer (informal)	
Farmer cooperation (informal, no marketing body)	
Buyer - Farmer (seasonal contracts)	
Buyer - Farmer (long terms contracts)	
Independent large farmer (with marketing body)	

The HAED team has prepared an overview of the observed governance structures that can be linked to the visited facilities during the 4 week mission and during prior visits by the HAED team. This overview is shown on the next pages.

Table 6: Observed governance structures in the Jordan Valley [6]

Facilities Name	Governance Structure	Source of fresh Vegetable & Fruit	Flow of Produces	Markets
A. Certified Postharvest Facilities				
1. Agri-Jordan Co. **2. Phoenix Agricultural production co. (DAMCO previous)** **3. Jordan Agricultural Produce Promotion Co. (JAPPCO)** **4. Greener Farms Jordan Valley**	Independent Large Farm Companies (with Marketing body) + Exporter-Farmer (Long terms contracts)	The sources of Vegetable of certified Postharvest facilities mainly received from their own certified farms in Jordan Valley, and sometimes received from small/medium farms based on long term contacts under the their supervision. The Facility owner focus on product market combination based on the pull supply chain model which gives the company more fruitful returns on investment.	The Certified Postharvest Facilities usually received vegetables from their own certified farms in bulk in plastic field boxes. Harvested product transported by refrigerated lorry from farms to packhouse at temperature of 5°C, then pre-cooled by forced-air, and stored temporary in the cold store for manual preparation such as washing, cleaning, sorting, grading and packing in hygienic environment based on International Market requirement and finally automatically palletized using high quality packing materials. Broccoli for export market packed in (200 g plastic punnet or in permeable plastic bag 500 g), each Broccoli Cartoon filled with 30 – 70 plastic container. At AgriJordan Facility Capsicum is automatically washed, dried, graded, and weighed using capsicum machine.	Fresh Produces meet the specific EU marketing standards **Extra Class:** Exported to West Europe (Hypermarket) **Class I , Class II:** Buy in Local Markets (Supermarkets, WSM).
B. Un-Certified Postharvest Facilities				
1. MOH'D ABU SEEDO EST.	Exporter - Farmer	The sources of Vegetable of uncertified Postharvest	Uncertified Facilities usually received vegetables from uncertified farms in Bulk in wood, plastic, or polystyrene Boxes, each farmer has same field	**First Class:** Exported to Russia, Gulf,

[6] Souce: HAED

2. Ra'ed Alhamshari trading EST. **3. Zahrat Al Wadi (Mohammad Hijazi)**	(seasonal contracts)	facilities mainly received from small/medium farmers based on seasonal or Long term contacts and sometimes vegetables are bought directly from Wholesale Markets. Facility owner export produces after preparation by his own risk,	box colour different than the other farmers. Facility Owner usually buy fresh produces on packhouse gate, after receiving, vegetables are dumped on tables or conveyer for manual cleaning, sorting and grading, sometimes fruit skin is cleaned manually with cotton tissue before packed in carton boxes, then stored temporary in cold room until uploading in refrigerated truck. For export marketing Tomato packed in 7-7.5 kg, cucumber 10-15 kg, capsicum in 5 kg cartoon or plastic crates	and Local Jordan Hypermarket **Class II:** Sell to Local WSM, or public vegetable Shops

Table 7: Observed governance structures near Amman Central Market [7]

Postharvest Facilities Name	Governance Structure	Source of fresh Vegetable & Fruit	Flow of Produces at facilities	Markets
1. Abu Jabeer logistics Company **2. A&M Sultan for fruit and Vegetable Company** **3. Taj Cooling Company** **4. Darb for trading & Refrigeration L.L.C** **5. Hammodah Son Company** **6. Fresh Fruits Co**	Large postharvest Companies (without Marketing body) Exporter-Farmer (Seasonal terms contracts)	The sources of Fruit and Vegetable of Postharvest facilities are from three Sources: 1. Amman Whole Central Markets via Middleman at Central market. 2. Seasonal Contracts with Small/medium farms. Facility Own Fruit Farms in High Lands	Postharvest Facilities usually received vegetables in different types, sizes, shape in wood, plastic, or polystyrene or Cartoon Boxes based on the produces source from (WSM, Seasonal contract farms or from their own farms). Fruit and Vegetables product transported to Facility via Unrefrigerated lorry from the farms or Central Market to the packhouse since as soon it received it will be precooled in the facility and prepared manually for sorting, grading and packing in Cartoon and then stored temporary in cold room before delivered by refrigerated truck to destination markets mainly Gulf Countries. If trader intend to export vegetables to whole sale markets in Gulf such as Saudi, Bahrain, Oman, UAE, Qatar, vegetables are mainly handled directly as received in the wooden, plastic, or polystyrene boxes without damping or sorting or grading, based on the importer middleman request then palletized and stored temporary for exportation to Gulf via refrigerated truck. If it intended to export to Gulf vegetable supermarkets, Bulk	**First Class:** Exported to Gulf Supermarket or Locally in Jordan vegetable supermarket **Class II:** Sell to Local public vegetable Shops

[7] Souce: HAED

7. Samih Alrajabi suns Co			vegetables are usually damped on table for manual handling (grading, sorting, packed, and repackaged in new type of cartoon) then palletized and labelled and stored for truck transportation to Gulf.	

The development stage of a sector and the market possibilities are factors that determine the form of governance. Also the level of risk the different players wish to take or are able to take, are factors that determine the form of governance. Thirdly, the size of the operation is a factor that is of influence. Often, different structures co-exist.

- A smallholder farmer usually likes his independence and sells at a local market. This is time consuming but this time is not considered a main issue.
  In case there is no local market nearby, middlemen will collect farm-gate paying a low price but cash.
- Medium farmers are more professional and tend to focus on the primary production. They sell at WSM or to traders after the harvest started
- Some farmers cooperate informally (relatives or from the same village). They exchange information on prices, production techniques etc.
- Some traders know their market and start to make contract with farmers accordingly (seasonal)
- When value chains are being established, the focus will shift from short-term to long-term cooperation with the aim of improving the chain, consistency in quality and supply. The market decides what products, which quantity, supply over an extended period of time. The 'chain-director' (often the trader), makes a production planning and arranges production contracts. Everybody knows beforehand more or less what to expect. Where to sell, what price etc.
- Some farms are large enough to make their own planning and meet the requirements of their buyer(s) in terms of quantity and supply window.
- Farmers that are not satisfied with a trader or farmers that are willing to take marketing risks in exchange for a potential higher price, may form a (marketing) cooperative. A pre-requisite for these cooperatives to work well is that there should be a clear added value for cooperation. One such an added value can be that the products can only be sold for good prices at an export market and one farmer cannot afford the infrastructure to export. The farmer has in this case a choice to either sell to a trader or jointly with other farmers invest in own infrastructure.
- When some parties in the market become very powerful due to their turnover and purchase capacity, a cooperative may be not big enough or needs a wider assortment to meet the requirements. This leads to the formation of second tier cooperatives (e.g. www.unicagroup.es)

In order to fill this gap, we recommend to assist the pilots, independent of the organisational structure they have, with their strategy determination and translation of the chosen strategy into concrete SOPs (standard operating procedures) for postharvest handling, shipping and pro-active market feedback as well as cooperation agreements between pack house and supplying farmers.

Frequently observed governance structures*							
Complexity	Governance structure	Potential markets	Food safety risks	Non-payment risks	Risk of not meeting commitments	Power balance	Investment strength
	Independent SHF	*Domestic markets, often via WSM*	*High, limited incentives for farmer to produce safe food*	*Farmer <= buyer/WSM: low* *Buyer/WSM <= market: low*	*Low: only adhoc commitments given by all stakeholders*	*Unequal: farmers have to sell harvest anyway*	Unique per structure: - budget of SC actors - cofunding availability - donor commitment - investor availability
	Independent medium farmer (without marketing body)						
	Buyer - Farmer (informal)						
	Farmer cooperation (informal, no marketing body)						
	Buyer - Farmer (seasonal contracts)	*Domestic and export markets, internal multinationals with local production facilities*	*High for domestic, medium for export, low for multinationals*	*Farmer <= buyer: low* *Buyer <= domestic market: low* *Buyer <= export market: high* *Buyer <= multinational: low*	*Farmer: high if market prices rise* *Buyer: high if market prices fall*	*Equal/ unequal*	
	Buyer - Farmer (long terms contracts)						
	Independent large farmer (with marketing body)	*High value domestic and niche export markets*	*Low, high food safety requirements from markets, risk of loosing image (brand)*	*Farmer <= market: low* *Cooperation <= dom. market: low* *Cooperation <= export market: medium*	*Low: image/reputation of all actors requires meeting commitments*	*Equal (exception is sales to very large purchase organizations)*	
	Farmer cooperation (formal, with marketing body)						
	Cooperation of cooperations	*Western supermarket chains*	*Low, implementation of GlobalGap.*	*Farmer <= cooperation: low* *Cooperation <= market: low*	*Very low*	*Equal*	

** Many hybrid structures exist*

Figure 6: Governance structures

4 Suggestions for embedding in HAED

The authors of this report are involved in multiple project intending to upgrade postharvest systems in Western economies and developing countries. Section 4.1 discusses Jordan's postharvest challenges in an international context. In doing so, learnings of other regions worldwide, if relevant for Jordan, are listed for benchmarking purposes.

Secondly, the authors share their thoughts on the HAED approach by discussing how different categories of stakeholders (section 3.3.1) can benefit from the project. In addition, the categories that have the highest potential for project success are discussed.

Finally, individual recommendations for embedding are listed in section 4.3.

4.1 Jordan's challenges in an international context

Section 3.4 elucidates on six gaps in Jordan post-harvest systems. An overview is shown in Table 8.

Table 8: Observed gaps in Jordan's post-harvest systems

Gap 1: Limited pull production (chicken egg-dilemma)
Gap 2: Knowledge on quality
Gap 3: Limited pre-cooling
Gap 4: Image of Jordan Produce / No international value to Jordan produce
Gap 5: No GlobalGap certification
Gap 6: Governance structures to facilitate continuous improvements

These gaps are typical for many emerging countries like India, Iran, Kenya, etc. Overcoming these gaps is often observed as a challenging, long-term process of trial and error. Nevertheless, there are countries that have successfully done so.

In the view of the authors, the developments of the Spanish horticultural sector could serve as an example to solve gaps and introduce potential solutions of the current state of the Jordan horticultural sector. Turkey, as a country, shows some similarities as well.

Therefore, section 4.1.1 and 4.1.2 introduces the history of both countries first. Secondly, the benchmarking opportunities for Jordan are discussed in section 4.1.3.

4.1.1 The Spanish horticultural sector

The horticultural sector in Almeria (Spain) is based on protected vegetable crops. Currently approximately 30.000 hectares of plastic covered crops are under production concentrated near the city of Almeria. The production system is based on relatively small-scale family farms. The sector was developed in the sixties by the government providing infrastructure (water, electricity, credits and extension) and allocating plots to settlers. The family nature of the farms and their reduced size in terms of land use were characteristics that appeared in the beginning of the sector's development but have endured until the present day. Still today, the estimated 30.000 hectares covered with plastic greenhouses is divided among 13.500 small-scale farmers.

The horticultural sector of neighbouring Murcia is based on big commercial companies that started to develop primary production. At first focused on open-air tomato, later also greenhouse tomato and since the mid-eighties, open field production of especially lettuce, broccoli and stick celery. Nowadays, this region is mainly known for its open field vegetables production. Apart from the big producers, also smaller greenhouse producers started their production to the example of Almeria. Here the

government only played a main role in water supply. For technology, Salinas (USA) was taken as an example.

In recent years, a sustained investment has been made to improve food safety. Almería has the highest density of accredited laboratories, and waste management has improved substantially because of rural hygiene plans and agricultural best-practices protocols.
However, most notable in recent years is the «Green Revolution» in the field of biological control based on the use of natural enemies to control organisms deemed harmful to plants.
This natural method of eliminating pests using beneficial insects improves the productivity of the crop and protects the environment by drastically decreasing the use of phytosanitary products and working to achieve «zero residue».
Its practice began in 2005, and the results until now have been excellent. According to the Ministry of Agriculture, Fish and Environment (CAPMA) of the Regional Government of Andalusia, 26,720 ha were treated with biological control techniques in the 2013/14 season.
It represents 93% of the surface and 65% of the production of Almería, thus ranking Almería as a world leader in total volume grown with biological control techniques and resulting in a large competitive advantage over other production regions.

Commercialization:
Since the advantage of the sector is in North West European markets during wintertime, the sector is highly focused and dependent on export. This fact and the size of the farmers results in the co-existence of two commercialization systems that exist next to each other and are complementary. Approximately 50% of the vegetables are marketed via 'Alhóndigas', auction systems located in the producer area. Another 50% is marketed via Cooperatives (or export companies).

Auction system: This concerns a physical place (near the greenhouses) where offer (vegetables) is brought together by the farmers in the area. The auction is equipped with cold storage and sometimes sorting and packing lines. The farmers' produce is auctioned to wholesalers, traders, exporters, etc. A fee (commission) covers the costs of the auction. For farmers, the advantage is that the price is fixed very soon after harvest, with limited costs added and payment is guaranteed.

Cooperatives or Agricultural Companies (SAT or SA): These concern companies (owned either by the producers supplying the vegetables or not). Sales are made based on commercial agreements and supplied to the customer (often in North West Europe). In addition, these companies always have cold storage, sorting- and packing facilities. Payments are usually weekly and after supply to the customer. This implies an additional risk level for the farmer.
This form of commercialization has the following advantage:

- Enabling of standardization and certification of the product, influencing the quality and in the incorporation of added value.
- Farmer access to agricultural supplies and technical advisory services
- Availability of real-time market information: quantity and quality of the product.
- Facilitation of production planning.
- Effective promotion of sales by categories (Classes)
- Homogenize prices.
- Decrease dependence on the external marketers.
- Increase the added value of product through development of brands, packaging, etc.
- Promote integrated production

In the long run, the system where sales are made based on commercial agreements (e.g. the cooperative system or an export/ marketing company with fixed suppliers) has the advantage of adapting in an early stage to the changing requirements of the market. It is also more suited to supply large supermarket chains directly.

In the province of Murcia, most of the commercialization is done by large privately owned companies that produce themselves, own their own pack stations with cooling facilities and have their own export department. Also, the possibility to become a member of a cooperative or supply via an auction exists for smaller farmers here.

Informal trade or purchases by middlemen hardly exist.
Access to West European markets that need lots of fresh vegetables during winter, is one of the main drivers for success. It provides the cash for investments and improvements. Anticipation to this market's needs is important.

The cooperatives as well as the big private companies are the main initiators to translate the market needs into practice (varieties, pre-cooling, sorting, packing, IPM, certification, consistency in supply (planning) etc. Government mainly supported with infrastructure and finance in start-up phase[8].

4.1.2 The Turkish horticultural sector

Turkey's greenhouse horticulture is concentrated in the Mediterranean and Aegean regions, with Antalya as the main area of concentration. Open field cultivation can be found for example in Bursa or the area between Mersin/Tarsus/Adana. The climate is quite favourable for greenhouse production. However, the long-term minimum average temperature for Antalya is 9.9 C. This puts the area in the same position as Almeria. During several weeks in winter, tomatoes may stop production because the greenhouses are not heated and the low temperature stops fruit development[9].

The greenhouse production is generally small and family-owned (smaller than Almeria). The government used to support investment in the sector by means of investment subsidies but stopped this already in 1996. Turkey has made moves to adopt EU Common Agricultural Policy but most pre-accession implementation is currently at a low level.

The sector has the advantage of a large local market. Production/demand ratio = 107%[10]
After liberalization of the seed imports in 1980, the sector was able to start the production of vegetables for the international markets as well. Turkish traders also have quite good networks in former CIS countries, like Russia, Ukraine and Central Asia and reasonable logistical access[11]. Turkey is less export oriented than Spain.
Still, Turkey exported 1.1 million tons of fresh vegetables in 2016. Which is approximately 4.5% of the total production.

Turkey exports most of its fresh fruit and vegetable to Russian Federation. This market constitutes a 17% market share of Turkey's total fruit and vegetable export with $ 331 million. Iraq is the second important market with 15 % market share with $ 293 million. Germany is the third important market with $ 201 million fresh fruit and vegetable export with 10% market share. Ukraine, Saudi Arabia and Belarus are the other important export markets of Turkey[12].

When only vegetables are taken into consideration, the market share of Russia seems even higher.
Russia 38% • Iraq 11% • Bulgaria 10% • Germany 8% • Ukraine 7% • Romania 6% • Others 20%
The exported vegetables are as follows: Tomato 57% • Pepper 12% • Cucumber and gherkin 9% • Others (onion, watermelon. Gherkin, carrot etc.) 22%[13].
Export subsidies on vegetables are a competitive advantage but the sector also faces some problems;

- Political and economic instability resulted in a strong devaluation of the lira recently and since there is a strong dependency on imported inputs, the production costs increase substantially.
- Poor market systems and lack of grower cooperatives[14].

[8] source: El modelo Económico Almería basado en la agricultura intensiava' Instituto de Estudios de Cajamar
[9] source: Turkish greenhouse industry; past, present, future
[10] source; general status of the vegetable sector in Turkey, Kazim Abak 2015
[11] source: yms.org.tr = Board of Turkish Sector of Fresh Fruit and Vegetables
[12] source: www.virtualmarket.fruitlogistica.com/ en/Mediterranean-Fresh-Fruit-Vegetable-Exporters-Association,c43718
[13] source; general status of the vegetable sector in Turkey,Kazim Abak 2015
[14] source: Turkish greenhouse industry; past, present, future

- Although several companies are aware of food safety issues in export markets and are certified, the sector as a whole has not yet made the transformation in IPM and environmental protection like this was realized in e.g. the Netherlands and Almeria. This gives a disadvantage in some markets already and is a competitiveness issue for the future, in other markets as well. There are issues from time to time with EU refusing Turkish vegetables after MRLs were exceeded. The country seems not very transparent about what happens with returned produce[15].

4.1.3 Benchmarking opportunities for Jordan

Section 4.1.1 and 4.1.2 show developments over time in both Spain and Turkey that relate to current challenges of current fresh food supply chains in Jordan.
Especially the developments in Spain show that multiple solutions can be implemented leading to a more effective agrifood sector. The main learning of the existing solutions is that as soon as cooperatives exist in an area, farmers may well choose to sell to an exporting company or become members of a cooperative to get involved in the marketing themselves this way. The existence of cooperatives is important to assure that producers have alternatives and the possibility to get a reasonable price for their product. In addition, long-term cooperation models between an exporting company and farmers are well possible. This model suits farmers that want to receive cash at harvest and want to focus on production rather than on being involved in the exporting process. However, if no cooperatives exist in an area, there is a high chance that farmers depend too much on middlemen for marketing their vegetables. This results in a low bargaining power and too low prices for the farmer. This in turn results in a lack of investment capacity to further improve yields, acreage and quality, thus hampering sector development.
Opportunities with regard to a Spanish auction system are limited as buyers prefer not to use these systems (the Dutch auctions disappeared mostly under pressure of the big buyers).
It can be noted that in Turkey the farmers are less off than in Spain due to lack of cooperatives which makes them too dependent on middlemen whereas in Spain large exporting companies buying from farmers, need to pay reasonable prices because the farmers have cooperatives as an alternative.
For Jordan this means that the long-term cooperation models should be supported. This can be an exporting company with long-term supply contracts with farmers. Next to that, a cooperative model would be preferred to set up with farmer members and transparency in the chain regarding costs and margins.
Both systems have the potential and capability of adapting in an early stage to the changing requirements of the market in terms of food safety, MRL's traceability, certification etc.
Both systems can work and coexist. It depends on ambition and capabilities of the involved supply chain actors. Without supply chain actor commitment of a co-produced solution, any project is likely to fail in the long term. Moreover, many specific conditions exist that make duplicating a development in e.g. Spain to Jordan non-effective. The ambitioned developments in Jordan will require customization.

Nevertheless, conditions that were observed in Spain to provide important learnings:

1. Access to high-level markets. Successfully supplying such a market leads to opportunities upscaling on country level. Moreover, it creates investment as high margins can be used for upgrading. Spain has successfully used the Northern-European markets as a cash cow for this purpose. Jordan has to a certain extend the possibility to do the same by supplying the Russian markets (described in section 3.1.1)[16].
2. Improve competitiveness: Spain has improved its competitiveness by effective production with integrated pest-management. Jordan could potentially do the same with regard to the Russian market. Quality, and more specifically food safety, improvements can improve image, and thereby prices, significantly.

[15] source; Turkish vegetables contain too many pesticides to be sold in EU., Heinrich Boll Stiftung
[16] Additional market research is advised though.

4.2 HAED approach

During the visit, HAED elucidated on the two-way approach that the team wants to execute. The first approach consists out of individual support for individual farmers. Resources have been allocated for multiple farmers. Based on the visit of the authors of this report, the focus will most likely be on effective implementation of pre-cooling, including the necessary operational training. Additionally, these individual farmers can participate postharvest training that will be organized in Jordan.

The second approach is based on relatively larger pilots involving 5-10 stakeholders of which most are farmers. Trading, storing, sorting, packing, exporting and branding experience is preferably also present among farmers or other stakeholders. The pilots preferably will involve the expansion of existing facilities, not the building of a new one, because sufficient facilities are already present and not fully utilized. The pilots will also include a process of governance building. Training on postharvest management is also included in the pilots.

The two-way approach is summarized in Table 9.

Table 9: Two-way approach HAED project

Individual support	Pilots
Resources for multiple 1:1 support projects	Resources for 2 pilots
Individual farmer	~5-10 stakeholders per pilot
Most likely focussing on pre-cooling	1 pilot in Jordan valley
Including training on postharvest management	1 pilot in Jordan highlands
	Most likely based on expansion of existing facilities
	Including a process of defining an effective governance structure
	Including training on postharvest management

The authors of this report do connect to the two-way approach. Section 3.3.1 defines three observed categories of stakeholders:
Category 1: Small to medium sized farmer (groups)
Category 2: Medium farmers facilitating niche export markets
Category 3: Large farmers / buying organization with effective (export) facilities
Farmers out of the first category, that in the end do not ambition to join a cooperation or any other form of collaboration with other farmers, can benefit from the HAED project by the individual support. With regard to pre-cooling, a quick win leading to significant quality improvements can be realized.

The pilots are especially beneficial for collaborations between farmers from category 1. The participation of an anchor farmer, that potentially receives a sales premium, with a broad network (category 3) is advised participate as well to build trust between all farmers and to realize access to premium (export) markets though.
The authors of this report advice to take small steps and start with building a local brand before exporting. The demand for high quality local produce (high-end supermarkets) is sufficient. In doing so, quality improvements can be realized because short-term feedback of local clients is present. In doing so, the learning loop will be short and risks are smaller because volumes of local orders are smaller than order of export clients. Moreover, in supplying to local clients, the visibility towards non-participating farmers and other stakeholders will be bigger, leading to larger and more time-effective opportunities to upscale a pilot once successful.

4.3 Recommendations for embedding

4.3.1 Design most effective facility including a light business plan.

The desired postharvest will be designed in cooperation with and implemented by supply chain actors. The authors advice to realize a facility design and a business plan light during the project. The goal of the facility design is to meet market (quality) requirement: both functional and technical. The goals of the business plan light is to validate financial competitiveness before actual implementation. Both the facility design and the business plan light are discussed in more detail below.

Facility design

- Functional design
  On the basis of the (expected) amount of product that will be handled in the packing house, the market requirements of the clients and logistics demands a first drafting of the different cooling and conditioning facilities will be made in a spatial optimal design. This includes questions as: what product(s), what volumes in what period, how long, what location (close to production areas or close to market outlets), what are the product specifications of the client, what is the destination of the product, what routes, what transport modalities, who is the owner, what is the (proposed) business model, what is specific legislation concerning warehousing. This is the Functional Design. This phase will be characterized as gathering information from the owner/user of the cold store facility and looking forward to the developments in the next 5-10 years.
- Technical design
  The technical design is a drafting (a blue print) of the different cooling and conditioning facilities that will be made in a spatial optimal design. This includes a description of program of requirements of refrigerating system and system choices concerning the conditioning of the products related to the packaging in use. This concerns specifically the choices that need to be made on: cooling capacities, refrigerants, coils location and dimensions, ventilators, control and registration systems and spatial arrangement of the stores, the sorting area, ripening and processing areas. The exterior demands of the building will be taken into consideration. Conceptual drawings of the spatial design and the required technologies are included.
  The technical design does not include architectonic drawings and calculations of buildings but only concerns the technical requirements of the proposed postharvest equipment.

Business plan light

The effect of an investment in cooling/ grading /packing facilities will be made visible by means of a business plan light (BP). This means a relative simple plan, NOT bankable, and calculations with a scope that is limited to the cooling/ grading/ packing and transport to destination of sales and excluding any DESTEP analysis of the foreseen market, market analysis. The BP will make use of available information on input costs to be provided by the partner(s) in the pilot that will be set up and/or information already available via the project (e.g. markets).
The Business calculations will be based on:

- assumed purchase prices for the vegetables farm-gate;
- assumed sales prices for packed product (price at location of transfer) (Class 1 and 2 in case applicable);
- Investment costs in equipment used for upgrading facilities (pre) cooling, grading etc.
- Operational costs of this equipment (maintenance, depreciation, running costs [hours x Kwh x price]);
- Consumables (carton boxes, PE foil, mesh, pallets, flow-pack etc.);
- Labour (hours per ton x wages);
- Exporting costs (or supply to retail) including transport by truck, harbour handling (fobbing), sea freight.

The business plan text will also focus briefly on strategic orientation, SWOT, Risk assessment and will underline the advantage and feasibility of the investments to be made in terms of (assumed) improved price, risk reduction and market access.

4.3.2 Explore opportunities for governance building

Section 3.4.6 shows nine frequently observed governance structures globally and which of these were observed in Jordan. The choice for a specific governance study or an unique hybrid structure requires customization. The six elements (Table 5) of each structure need to be evaluated in detail with each stakeholder individually and with all stakeholders jointly as a group. The ambitions and preferences, mostly related to preference for focus on primary production or forward chain integration, the amount of risks per stakeholder and the related financial returns of these risks, of the involved stakeholders needs to be leading in this selection and design process.

The authors advice to allocate significant time and resources to this process.

4.3.3 Invest in pre-cooling facilities of individual farmers

Pre-cooling is important to bring down the produce temperature to its optimum as soon as possible after harvest. The consequence is that the installation must be available close to the farmers in order to start the pre cooling soon after the harvest moment. A second consequence is that the pre-cooling capacity is limited because after several hours (depending on the product and harvest temperature), the produce is moved to room cooling and the pre-cooler can be used for the next batch.
There are 5 main systems for pre-cooling.

1. **Room cooling:** Passive system. Cooling can take many hours
2. **Forced-air cooling:** Actively pulling cold air through boxes. Fast cooling
3. **Hydro cooling:** Submerging in or sprinkling with cold water, possibly combined with washing/disinfection.
4. **Vacuum cooling:** Fast cooling (20-30 minutes) in sealed chamber
5. **Ice cooling:** Cooling by adding ice to the product

For Jordan we recommend forced-air cooling because it needs a relative low investment and because it is suitable for all possible products we'll work with.
Forced air pre-coolers come in stationary form or tunnel-like.

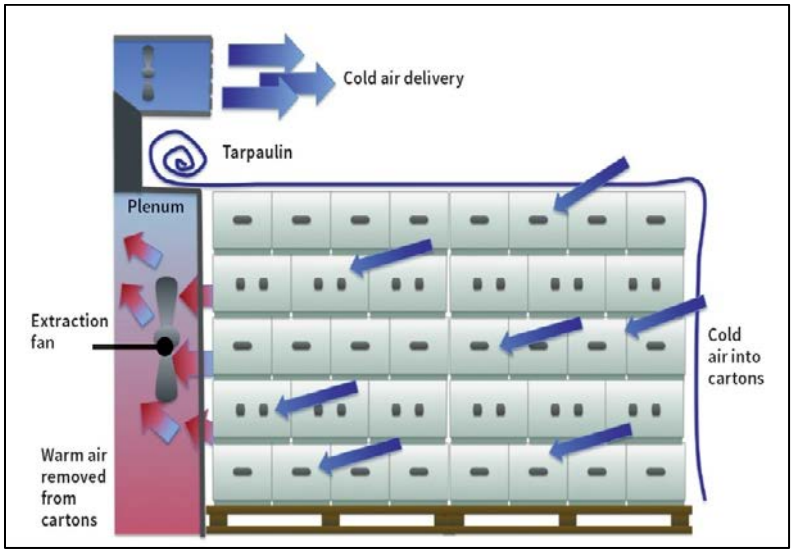

Figure 7: example of pre-cooling

4.3.4 Showcase Global GAP

For farmers to be able to meet export markets' standards, they should implement a GAP system. First, the chemical use should be registered and justified. It will help farmers to a next level of performance and farm management. The government runs a program that test GlobalGap certified companies randomly and issues export certificates stating 'Free of residues' based on these checks. This saves much time during the export process.

We recommend to implement GlobalGap at participating farmers and to make it a pre-requisite to participate. It will be a showcase for other farmers to visit and learn and make the step to implementation themselves easier.
A showcase GlobalGap consists of 2 parts:

1. **Implementation.** Checklist for 'all farm base' and 'Fruit & vegetable' modules are publicly available in several languages, including Arabic on the following website: https://www.globalgap.org/uk_en/for-producers/globalg.a.p./integrated-farm-assurance-ifa/crops/FV/. Farmers can implement themselves, but in practise, they need a consultant to help them with the implementation. Partly to advise and partly to be in a structural approach that ensures their commitment to continue and finalise the implementation. GlobalGap advise is available in Jordan
2. **Certification.** After implementation, an independent accredited auditor must check in order to be certified. There are no auditors in Jordan but they can easily be flown in from Egypt or India by SGS in Amman.

4.3.5 Study the Russian market and study Turkey as a competitor

Section 3.1.1 shows that the Russian Market (Moscow) is of significant importance to the development of the Jordan Valley. However, many producers and exporters experience to suffer from a chicken-egg dilemma:

- ⇨ find a market player first, that will request an upgraded supply chain or
- ⇨ upgrade the supply chain first, that requires a profitable market to gain return on investment

Ideally, both market accessibility and supply chain development need to go hand in hand.
To facilitate this practically, HAED project could perform a market study within work package 1 involving Jordan entrepreneurs.

Additionally, Turkey is supplying to the Russian market as well and has established steady relations with buyers on the Moscow WSM. Supplies consist of Turkish produce and produce from Jordan bought by Turkish traders, although trading Jordan produce is very limited currently as a result of the road through Syria being blocked. At this moment, it is unclear which country is more competitive during which period of the year. Moreover, Jordan farmers face newly introduced VAT on their production, while the rumour goes that Turkey's farmers gain an export subsidy and tax grace when exporting. To what extend this rumour is valid and to what extent this influences the competitiveness of Jordan with regard to supplying to the Russian market is unclear. Therefore, it is advised to give attention to this matter as well.

In this respect. The Syrian war forces Jordanian exporter to do their business with Russia directly which can surely be an advantage but apart from market knowledge, also requires relation building with Russian buyers in order to limit the risks involved (especially when for example 6 containers are at sea).

4.3.6 Create quality awareness

Section 3.4.2 discusses a gap with regard to knowledge on quality. Postharvest quality management is a multidisciplinary task requiring a range of skills e.g. knowledge of physiology, technology, technical and data analysis, experimental design, communication.

The authors advice to organize a training on postharvest quality management for stakeholders that will be involved in HAED. Ideally, the training consists out of:

- the latest insights in the biology of postharvest development, ripening and deterioration processes in fresh horticultural products;
- the most important factors for measurement, evaluation and modelling of product quality and loss; and
- current technologies for storage, packaging and handling.

Additionally, we recommend to make quality loss measurable. This should preferable be done by comparing the difference between pre-cooled produce and produce that was only put in a cold room

by simulating the storage and transport conditions until final destination (make use of loggers). This will help create awareness with farmers and pack station management of the effect on the product until final destination. Because usually they only see the product until loading. Also the product should at certain intervals be followed by loggers from moment of harvest to loading. Data should be analysed and lead to improvement in the postharvest logistics in order to make the farmers aware of the effect of their post-harvest handling at and directly after harvest.
In addition, the development of standard operating procedures (SOPs) for postharvest handling including a SOP for pro-actively seeking market feedback on quality and improvement needs will be included to overcome the quality awareness gap.

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